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# Relationship between big five personality factors, problem solving and medical errors

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## Abstract

**Background:** Human behavior is recognized as the main factor in the occurrence of accidents (70–90 percent), with human personality and problem solving ability as two related factors in the occurrence of medical errors (annually 42.7 million in the world). The objectives of this study were to investigate the relationship between personality factors, problem solving ability and medical errors.

**Material and methods:** This study was a questionnaire case control study. Information on 49 members of medical and nursing staff with medical errors (case group) and 46 without medical errors (control group) were analyzed. To collect the data, two Heppner problem solving questionnaires and the NEO-Five Factor Inventory were used, which were completed by the study population.

**Results:** The results illustrate that individuals without medical errors showed higher scores in conscientiousness, extraversion and agreeableness and lower scores in neuroticism than those with medical errors. Individuals without medical errors also showed higher scores in problem solving ability scales than those with medical errors.

**Conclusion:** Results of this study, suggest that personality factors and problem solving ability are related to medical errors and it may be possible for hospital authorities to use this knowledge when selecting capable medical staff.

Keywords: Health profession, Psychology

## 1. Introduction

Nowadays, modern medicine has created advanced therapeutic facilities and effective care processes that have improved health and treatment, but at the same time, due to the growing complexity of the treatment process, it has increased the probability of medical errors and harm to the patients [1]. In the ranking of causes leading to death, medical error is the 14<sup>th</sup> [2]. Patient safety has become very important in recent years and has been identified as an important international issue [3, 4, 5]. Reducing medical errors and increasing patient safety has become more important for investigators and policymakers in medical centers since the International Organization of Medical Science (IOMS) uses this term “To Err is Human”, which means it is natural for human beings to make mistakes [6, 7, 8, 9]. Available statistics indicate a widespread and worrying prevalence of medical errors, even in developed countries [10, 11, 12, 13, 14, 15]. According to the World Health Organization (WHO), from 421 million annual hospitalizations in the world about 42.7 million adverse events happened due to medical errors and inappropriate patient safety [2].

There are two main approaches towards human errors; the system approach and the person approach. The system approach concentrates on procedures and processes and the person approach focuses on unsafe behaviors that can cause errors [16]. Unsafe behaviors have been identified as the main factors in the occurrence of accidents, with the share of unsafe behaviors in the occurrence of events reported as between 70 to 90 percent [17]. A major issue in relation to human errors in the therapeutic system is that these errors are often predictable and preventable. According to studies, authorities could prevent 70 percent of medical errors [18].

In research on occupational accidents, factors such as physiological conditions of individuals [19], environmental conditions [20], and personality factors [21] can impact on human errors. Research also shows that one of the causes of an individual's personal errors is his/her personality which can directly influence these errors [22, 23, 24, 25]. The NEO big five personality theory is one of the classifications of character traits. In 1985, Costa and McCrae identified five main personality factors of neuroticism, openness to new experience, extraversion, conscientiousness and agreeableness [26]. Another aspect of the human feature that is also related to; personality type, behavior, cognitive and emotional factors is their problem solving ability [27], with problem solving ability also related to the individual's performance

[28], which in turn can affect human error rates [29]. The aim of this study was to investigate the relationship between personality factors, problem solving ability and medical errors.

## 2. Methods

### 2.1. Sampling method

There were 245 nurses and 52 physicians that had been working officially in the hospital. Medical errors had been recorded since the first day of employment, with additional information about those staff with the highest recorded number of medical errors. Sampling was done by census, and all people with the highest recorded medical errors and those without medical errors were identified from the information maintained and provided by the hospital's safety management and prevention department.

### 2.2. Study population

This was a case-control questionnaire study, designed to evaluate the relationship between personality factors, problem-solving ability and medical errors in 2018 in Tehran on the medical staff (nurses and doctors) in a military hospital. 120 medical personnel were identified in two groups of case (60 with recorded medical error) and control (60 without error or the lowest medical error recorded). 15 potential participants did not consent to participate in the research. Additionally information from 10 medical staff was invalid, and this data was not analyzed. In total information of 49 persons with medical errors and 46 persons without medical errors were analyzed. The inclusion criteria were; being a physician or nurse, in good general health, not supposed to have second jobs, lack of psychiatric disorders and personality disorders, lack of familial problems that could effect the performance of a person and having work experience of over 2 years. Individuals entered into the study must be completely satisfied, given detailed information on how to accomplish it and be clear that no personal identification details would be published. Written consent forms were completed by all participants. The informed consent was obtained from all participants. Ethic of this study was approved by the ethical committee of baqiatallah medical science university.

### 2.3. Data collection tools

To collect data, two Heppner problem solving questionnaires and the NEO-Five Factor Inventory (FFI) questionnaire were used, which were completed by the study population.

The Heppner Problem Solving Questionnaire is a 35-item Likert scale questionnaire. The problem-solving questionnaire by Heppner and Patterson (1982) has been designed to measure respondent's perceptions of their problem-solving behaviors and how people react to their daily issues. The problem-solving questionnaire, based on the rotation of the factor analysis, has three distinct scales including Problem Solving Confidence (PSC) (high scores on this scale indicate that the individual believes in his ability to solve his problem) with 11 questions and the score range of 0–55, Attitude-Avoidance (AA) (the person's general attitude to or avoidance of problem-solving activities) with 16 questions with score range of 0–80, Personal Control (PC) (indicating how much the person believes in managing his or her emotions and behaviors while problem solving) with 5 questions with score range of 0–25 and 3 additional questions that were not considered. The problem-solving questionnaire validation has been tested multiple times with several samples of subjects. Cronbach's alpha values are 0.72 for PC, 0.84 for AA and 0.85 for PSC and 0.90 for the overall questionnaire. The total score of the questionnaire was obtained within two weeks range from 0.83 to 0.89, which indicates that the problem solving questionnaire is a reliable tool for measuring the problem solving ability. Validity and reliability of this questionnaire have been reported in other studies and in all of the studies Cronbach's alpha is above 0.70 [30, 31, 32, 33, 34].

The NEO Personality Measurement Inventory is one of the most reliable questionnaires for assessing personality structure based on factor analysis. Based on this model, the personality can be explained by five strong factors. These factors include; neuroticism, extraversion, openness to new experience, agreeableness and conscientiousness. In neuroticism; anxiety, anger, self-awareness, irritability, vulnerability and depression are experienced by individuals. Extraversion is a feature in which the person is: enthusiastic, energetic, decisive, looking for excitement, warm and active, has passions, wit and optimism. Openness to new experience has such modes as imagination, curiosity, originality, breadth and artistic sense. Agreeableness has the characteristics of goodwill, flexibility, good nature, trust, forgiveness, cooperation, empathy, restfulness and tolerance. Conscientiousness includes features such as; precaution, perfectionism, accountability, organization, efficiency, planning, hard work, perseverance and tendency to succeed [35]. The questionnaire used in this study was NEO-FFI a short form of NEO with 60 questions completed in a Likert scale. For each factor, there were 12 questions. The score range was 0–60 for each factor. The NEO-FFI validity coefficients were found to be between 0.83 and 0.75. The long-term validity of this questionnaire has also been evaluated. A 6-year long study on neuroticism, extraversion and openness to new experience, showed validity coefficients of 0.86 to 0.83 in personal reports and in coupled reports. The validity coefficient of two factors of agreeableness and conscientiousness in two years interval was 0.79 and 0.63 respectively [36, 37].

## 2.4. Data collecting

Human errors taxonomy may include concepts of; slip, lapse and mistake [38, 39]. An another factor in human error taxonomy is violation [40]. Also according to the Rasmussen's Skill Rule and Knowledge (SRK) model, mistakes can be divided into skill-based, rule-based and knowledge-based [41]. The errors were recorded by the department of prevention and safety of the hospital, which included all of the above types of mentioned errors but did not differentiate between different types of errors. First, the list of physicians and nurses who had the most recorded errors (case group) and those who did not have the recorded errors or had the lowest recorded error (control group) were extracted from the archived data, and two questionnaires were completed. This included staff from each department of hospital (clinic, emergency, intensive care units (ICU), critical care units (CCU)) where they had been working. This study conducted in the form of single blind (participants were unaware of which group they were in) because of bias elimination.

## 2.5. Statistical analysis method

SPSS.ver22 software was used to analyze the data. Independent t-test, Chi-square, Fisher and Pearson correlation were used in this software. Significance level of this study was 0.05.

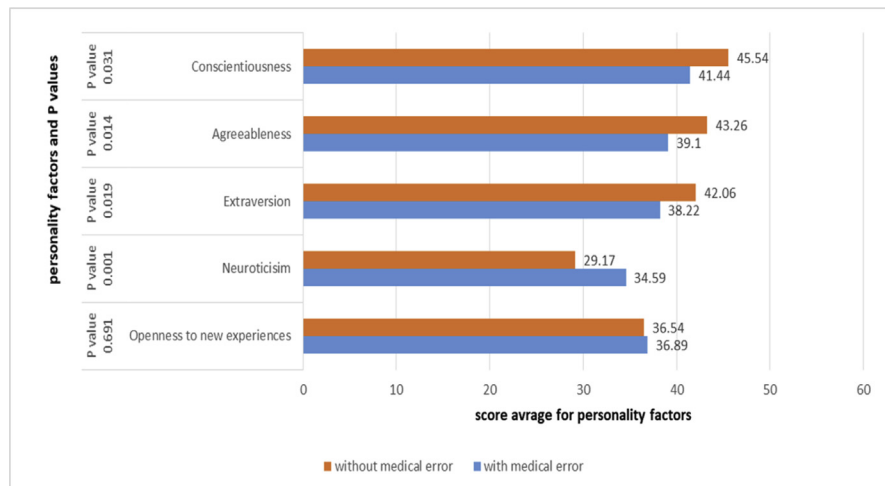
## 3. Results

Table 1 shows the demographic data for gender, age, working field, employment status and work experience. The data are matched between two groups as seen from the P values in the table.

**Table 1.** The demographic data of studied population.

		With medical errors	Without medical errors	P value
Gender	Male	27	21	0.237
	Female	22	25	
Age	<30	16	15	0.876
	31–40	17	19	
	41–50	12	9	
	51<	4	3	
Field	Physician	8	12	0.316
	Nurse	41	34	
Employment statue	Scientific board	2	2	0.686
	Official	20	23	
	Contractual	27	21	
Work experience <sup>a</sup>	<5	17	14	0.662
	5–15	24	25	
	16–25	5	7	
	25<	3	0	

<sup>a</sup> The work experience is measured by the scale of working years.

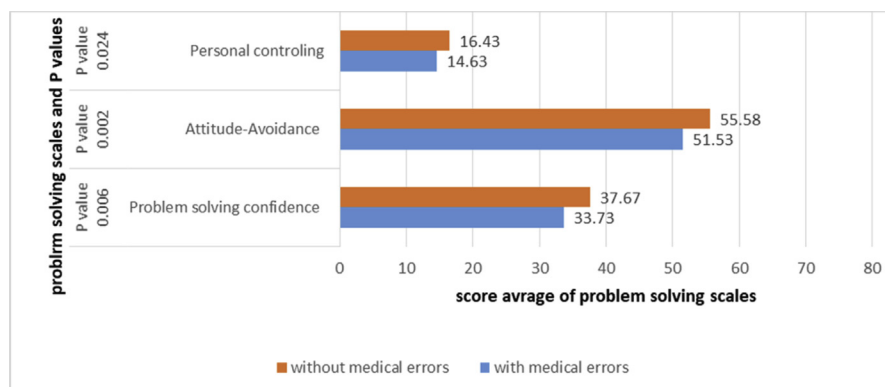


**Fig. 1.** Comparison of personality factors between two groups.

Fig. 1 (below) shows the average score of personality factors between the two groups. Score averages in individuals without medical errors are significantly higher than those with errors for three factors including; conscientiousness, agreeableness, and extraversion. Additionally scores for, neuroticism in individuals without error are significantly lower than those with errors. In the factor of openness to new experience, there is no significant difference between the two groups.

Fig. 2 (below) shows the problem-solving scales between two groups. Score averages in individuals without medical errors are significantly more than those with errors in all three scales (PSC, AA and PC).

Table 2 shows the relationship between five personality factors and three problem solving scales. There is a significant negative relationship between neuroticism with all problem solving scales. There is a positive significant relationship between conscientiousness with all problem-solving scales. Extraversion and agreeableness



**Fig. 2.** Comparison of problem solving scales between two groups.

**Table 2.** Correlation between personality factors and problem solving scales.

		Problem solving scales		
		Problem solving confidence	Attitude-avoidance	Personal control
Big five personality factors	Neuroticism	0.000 <sup>a</sup>	0.002 <sup>a</sup>	0.000 <sup>a</sup>
	Extraversion	0.000>	0.088	0.000>
	Conscientiousness	0.000>	0.001	0.000>
	Agreeableness	0.000>	0.105	0.000>
	Openness to new experiences	0.555	0.099	0.060

<sup>a</sup>Neuroticism has negative correlation with problem solving scales.

have no significant relationship with the avoidance-attitude; however, with other factors (PSC and PC), there is a significant positive relationship. Openness to new experience has no significant relationship with any of the problem solving scales.

#### 4. Discussion

The aim of this study was to investigate the relationship between the big five personality factors, problem solving ability and medical errors. The results of the study showed that those who had less medical errors had a significantly higher score in three factors of extraversion, conscientiousness and agreeableness. Those who had high medical errors showed significantly higher scores in neuroticism than those who had no errors. There was no significant difference in the openness to new experience factor. Also, individuals without medical errors, had significantly high scores in three scales of problem solving (PSC, AA and PC) than those with errors.

The health care process in hospitals is very complex and sensitive, as a result, the slightest negligence in the tasks can lead to defects. Nurses and physicians who have a high-level of conscientiousness demonstrate features such as; caution, accountability, being organized, efficiency, planning, and hard-working, which can all effect the performance of the individual. Findings from this study indicate it is possible that these people perform their medical duties better than those who have less of these characteristics, and consequently have fewer medical errors. Individuals with a high degree of conscientiousness present with good internal motivation and can work without external incentives (such as high wages, career promotion and encouragement, or fear of being fined in case of failure). They do well, and thus the error rate in these people is stable [42]. Costa and McCrae found that there is a negative correlation between neuroticism and conscientiousness [43] which is also consistent with our findings. Characteristics of personality that are involved in conscientiousness are also recognized as characteristics related to performance in Peabody and Goldberg's research, so that everyone who possesses these attributes tend to present a more efficient performance with fewer errors [44].

It has also been recognized that people who score higher in factors of extraversion present efficient performances in businesses with higher social relationships requirements like salesmanship [45]. In the nursing and medical profession, since there is a direct relationship with the patient, if the nurse or physician are extraverted, they may be able to communicate with the patient well, understand their problems better and thus have better performance [46, 47]. The medical staff with a high neuroticism may have greater levels of anxiety, anger, irritability, and depression. These features are factors that interfere with the function of individuals and cause them to fail to perform their duties well. These people need external motivation for doing their duties to a high standard and working with a low error rate. Given the variability of external motivations they tend to show unstable error rate [42]. Workers who have a high degree of agreeableness generally show a higher performance in their work, with both agreeableness and conscientiousness positively correlated [48]. Openness to new experience affects only the performance of individuals in cases where the person is in training and education. This variable does not make a significant difference between trained people (like nurses and physicians) at their work [44, 45] and is consistent with our findings.

In related with scale of problem solving confidence (PSC) people who do not trust their problem solving ability when they are facing a problem, they don't even try to solve it. So they may be able to solve them, but they won't even try to solve it because of low self-confidence [49].

Individuals who have control over these issues can make executive decisions such as planning, monitoring, assessment, and condition regulation. These people have knowledge about cognition and can set this cognition [49]. These features in individuals with personal control capabilities make it easy for them to organize and resolve issues and reduce the rate of errors. In cases where an individual does not have a tendency to solve a problem, he may even be able to solve it easily, but the lack of interest and willingness to solve it, will make an unsuccessful attempt in solving the problem [49].

In a study, it was found that there is a negative correlation between neuroticism and PC, and there is a positive correlation between conscientiousness and PC [50]. In the study on the relationship between personality factors and social problem solving, it was found that people with neuroticism have a negative view of solving problems. So that, they see problems as a threat to themselves and they have doubts about people's ability to solve problems. They are easy to surrender to problems. In contrast, people with extraversion and conscientiousness look positively and logically toward solving a problem. People who see problems as an opportunity to exploit and are capable at solving problems [51, 52, 53].

In a study that was done by Haghshenas and colleagues on the relationship between personality factors, human error and driving violations; it was found that people with



a high degree of neuroticism, score more errors and in higher levels of extraversion and agreeableness there was less driving errors. There was no significant relationship in the factor of conscientiousness [23]. In this study, except for the factor of conscientiousness, other factors are in consistent with our study. In another study, conducted by Avis and colleagues on relationship between the conscientiousness and the job performance of individuals, it was found that people with a high level of conscientiousness have higher cognitive performance. Also, high cognitive performance will cause job performance improvement and errors reduction [54, 55]. These studies are consistent with our findings. In a study by Hurts and colleagues on the relationship between personality and occupational performance, it was found that individuals with personality factors of conscientiousness, and extraversion showed better job performance, as well as those with a high emotional stability or low levels of neuroticism [56].

There were several issues that limited our study. In the majority of hospitals, information on employees was confidential and not accessing to the researchers, hence focusing on one specific hospital where access to data was granted.

## 5. Conclusion

According to the findings, it can be concluded that physicians and nurses with higher levels of agreeableness, extraversion, conscientiousness and lower levels of neuroticism have make less medical errors. Also, participants with a positive and logical vision to solve problems and have a higher problem solving ability, tend to illustrate better performance and less medical errors. Therefore, in the recruitment, selection and hiring processes in hospitals, the measurement of personality factors and problem-solving ability, could be used to identify and employ low-error and capable individuals. Also, when considering promotions, these features can be used to identify low-error individuals with the desired performance abilities to undertake important job positions within the organization.

## Declarations

### Author contribution statement

Mansour Babaei: Conceived and designed the experiments; Wrote the paper.

Mohammad Mohammadian: Performed the experiments.

Masoud Abdollahi: Contributed reagents, materials, analysis tools or data.

Ali Hatami: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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## Competing interest statement

The authors declare no conflict of interest.

## Additional information

No additional information is available for this paper.

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